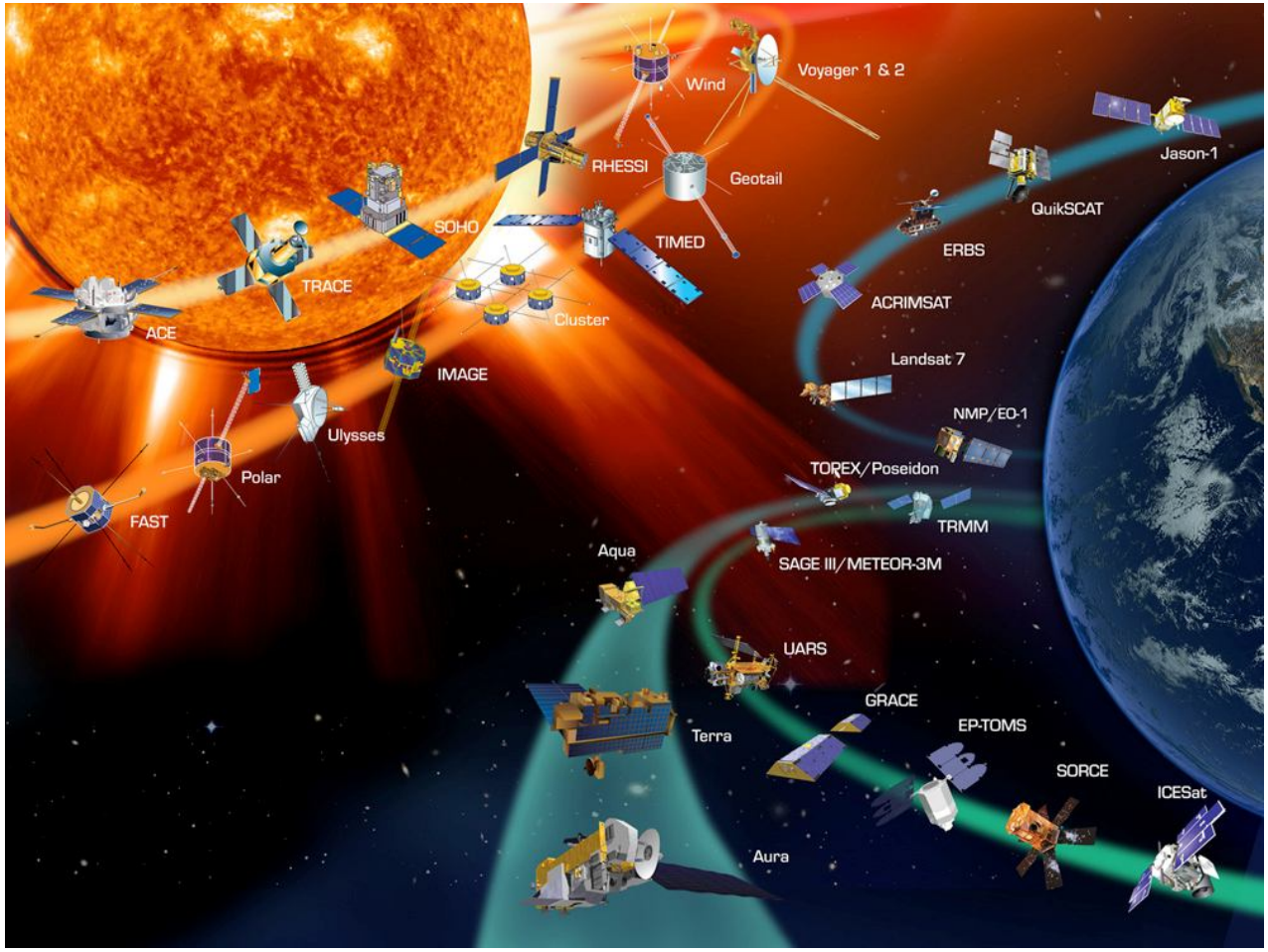
DDPP 2163 Propagation Systems

Satellite Communication

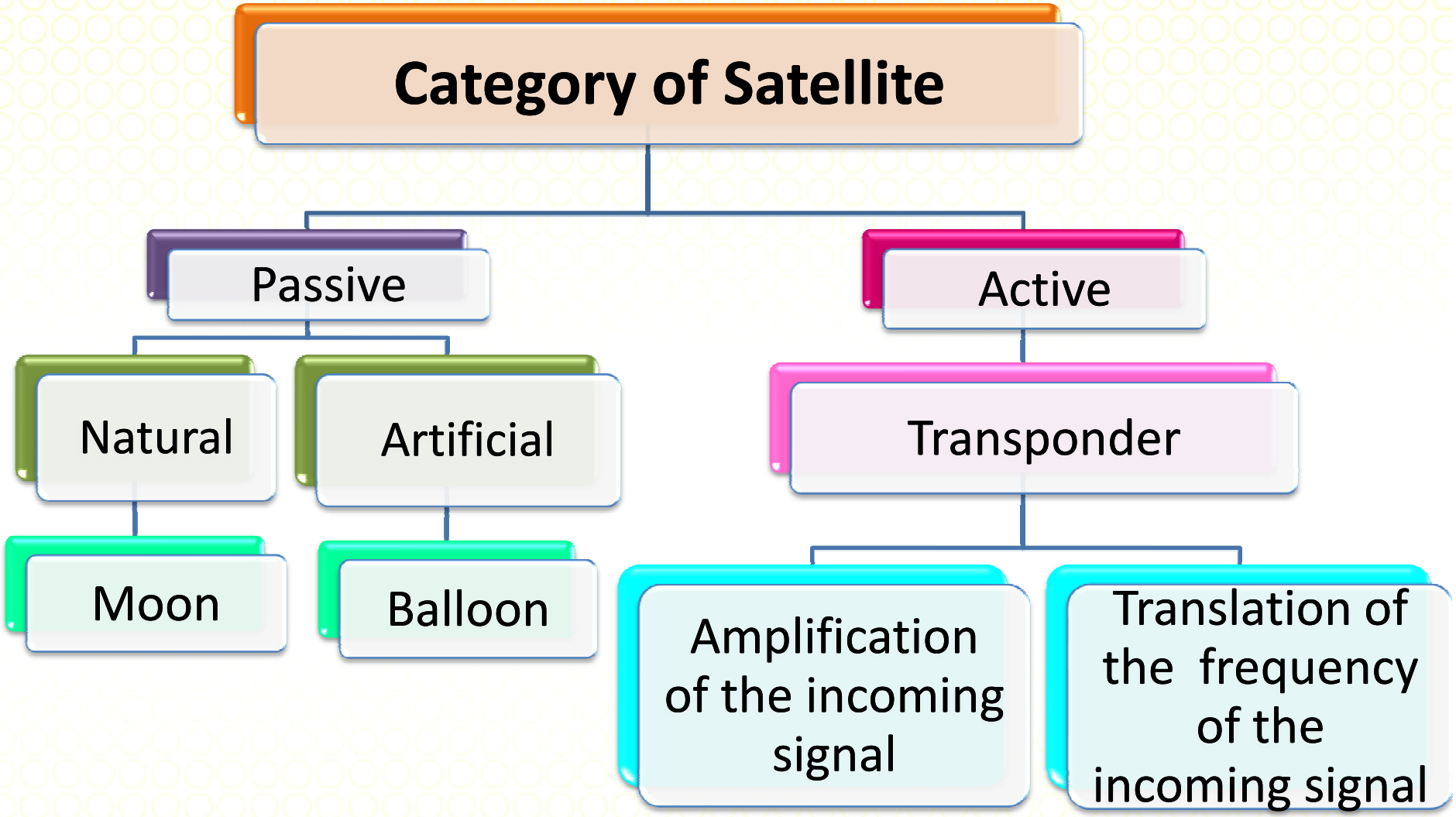
Satellite

- Two far apart stations can use a satellite as a relay station for their communication
- It is possible because the earth is **a sphere.**
- Radio waves **travel in straight lines** at the microwave frequencies used for wideband communications
- **Repeater** is needed to convey signals very long distances
- There are about 7000 satellites in the space, most of them are used for **communication**

NASA satellites



GEOSTATIONARY SATELLITE OBSERVATIONS OF AIR QUALITY


Category of Satellite
Passive
Active
Natural
Artificial
Transponder
Moon
Balloon
Amplification of the incoming signal
Translation of the frequency of the incoming signal

Satellite-Related Terms

- **Earth Stations** – antenna systems on or near earth
- **Uplink** – transmission from an earth station to a satellite
- **Downlink** – transmission from a satellite to an earth station
- **Transponder** – electronics in the satellite that amplify and convert uplink signals to downlink signals. A combination of transmitter and receiver.

How satellite works?

Earth Station sends a transmission signals to the satellite. (**Uplink**)

The satellite **Transponder** amplify and converts the signal

Transponder sends the signal down to the second earth station(**Downlink**)

Satellite Communication

- Users generate **baseband signals** and processed at the earth station and then transmitted to the satellite through dish antennas
- The user is connected to the earth station via some telephone switch or some dedicated link.
- The satellite receives the uplink frequency and the **transponder** present inside the satellite amplifies the signal and converts the frequency for uplink transmission

Satellite Communication

- The earth station receives the signal from the satellite through parabolic dish antenna and processes it to get back the baseband signal.
- This **baseband signal** is then transmitted to the respective user via dedicated link or other terrestrial system.
- Satellite communication system previously used large sized **parabolic antennas** with diameters around 30 meters because of the very faint and weak signals received.
- Satellites nowadays become stronger, bigger and powerful due to the size is smaller.

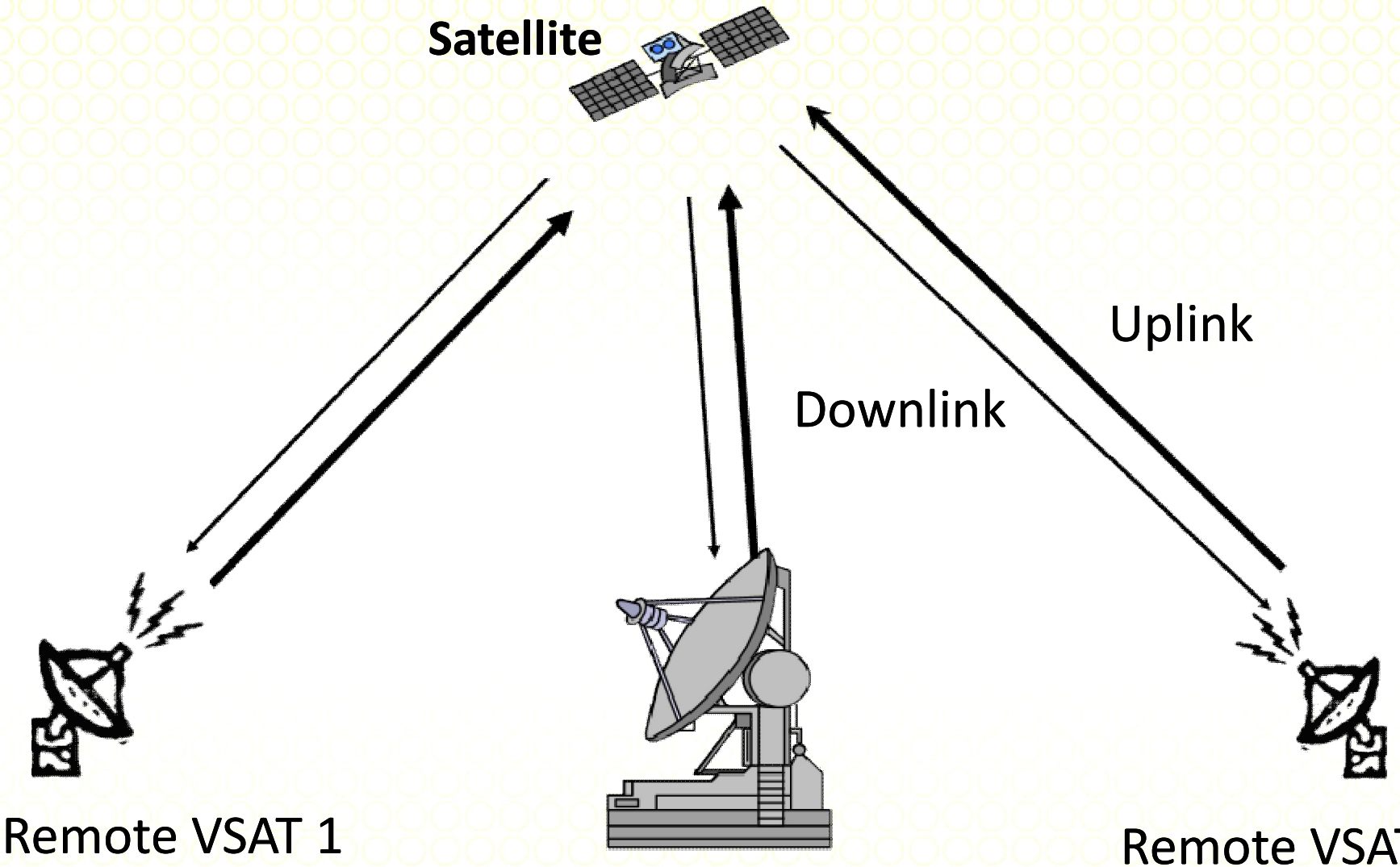
Range

- The distance a signal travels is inversely proportional to the frequency
- Repeaters extend range
  - Back-to-back antennas
  - Reflectors
- High frequencies are repeated/received at or below one mile
- Lower frequencies can travel up to 100 miles but 25-30 miles is the typical placement for repeaters

Satellite Network Configuration

- Point-to-point link
  - An earth station sends microwave signal to a receiver via a satellite antenna acts as a relay
- Broadcast link
  - An earth station sends microwave signal to multiple receivers via a satellite antenna

Satellite Link



Advantages of Satellite Communication

- The **coverage area** of a satellite is greater than that of a terrestrial system
- Transmission **cost** of a satellite is independent of the distance from the center of the coverage area
- **Higher Bandwidths** are available for use

Disadvantages of Satellite Communication

- **Cost** involved in launching satellites into orbit is too high
- Satellite **bandwidth** is gradually scarce
- Larger **propagation delay** in satellite communication than in terrestrial communication

Free Space & Atmospheric Attenuation

- The loss the signal undergoes traveling through the atmosphere.
- Changes in air density and absorption by atmospheric particles.

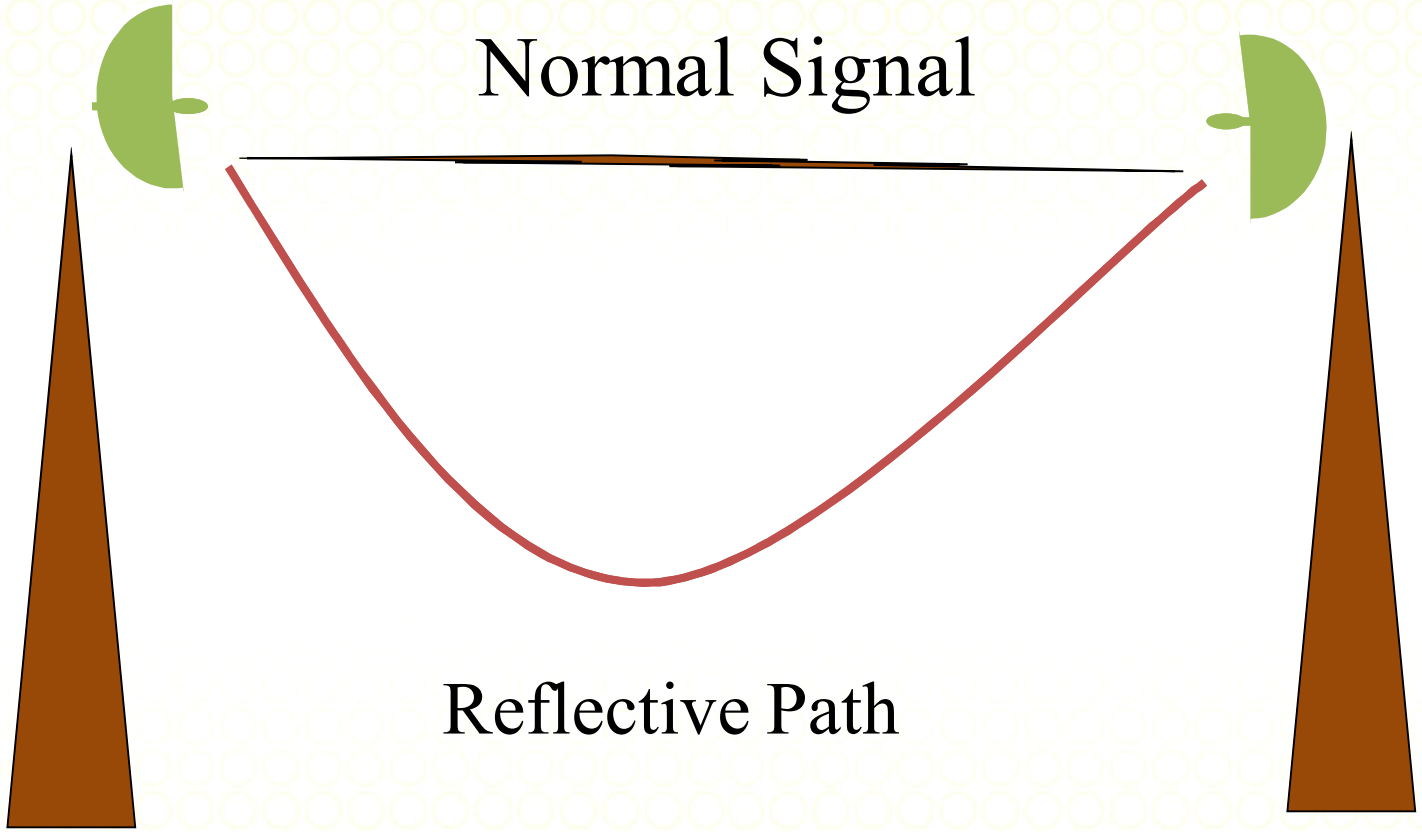
Free Space & Atmospheric Attenuation

- ***Reflections*** - the microwave signal traverses a body of water or fog bank; cause multipath conditions
- ***Diffraction*** – the result of variations in the terrain the signal crosses
- ***Raindrop absorption* or scattering** - the microwave signal can cause signal loss in transmissions.
- ***Skin Affect*** - high frequency energy travels only on the outside skin of a conductor and does not penetrate into it. *Skin Affect* determines the properties of microwave signals.

Line of Sight
Fresnel Zone Clearance

- Fresnel Zone Clearance is the minimum clearance over obstacles that the signal needs to be sent over.
- Reflection or path bending will occur if the clearance is not sufficient.

Microwave Fading



Caused by multi-path reflections and heavy rains

Interference

- Adjacent Channel Interference
  - digital not greatly affected
- Overreach
  - Signal pasts a repeater to the receiving antenna at the next station in the route. Eliminated by zigzag path alignment or alternate frequency use between adjacent stations

END